AUDIT OF TRANSFUSION PRACTICE DURING BURNS SURGERY AT THE RED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

By

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Contents

DECLARATION

I, Dr Anri Spies, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree to this or any other university.

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Abstract

Rationale: Major burn surgery can be associated with significant blood loss, often requiring transfusion of blood products. In an effort to decrease aforementioned blood loss, various blood conservation strategies have been developed, rendering older formulae to predict intraoperative blood loss ineffective and outdated. Currently there are no clear guidelines on when to transfuse burn victims but, the trend is towards employing a more conservative transfusion practice in an attempt to reduce transfusion related complications. The predicament has become one of containing cost by not ordering blood unnecessarily and/or excessively, versus putting a patient at risk by not having blood available when he or she needs it. A guideline, based on haemoglobin and extent of surgery, was drawn up at the Red Cross War Memorial Children's Hospital in an effort to rationalise preoperative blood ordering. The aim of this audit was to assess how well the implemented guideline was adhered to, and how accurately the guideline predicted the need to have blood products available in theatre during burns surgeries of varying extent.

Methods: After a guideline, based on expert opinion, had been drawn up and implemented, a prospective audit of practice was done from April 2014 to June 2015. Two hundred separate burn surgeries were audited. Data collected included haemoglobin levels, extent of surgery, pre-and intra-operative instructions to blood bank, and whether patients were transfused. Pre-operative instructions were compared to the guideline to test adherence, and to the ultimate need for blood to test accuracy. Additional data recorded were the adherence to surgical plan (extent of surgery).

Results: Five of the 200 cases were excluded due to incomplete data, leaving 195 cases. Blood was ordered according to the guideline in 131 (67.2%) cases. There were two groups where adherence was particularly poor. In these patients the guideline suggested that only a group and screen was necessary – a category for which it would also be difficult to assess how accurately the guideline predicts the need for blood. After excluding these two groups, the preoperative instructions to the blood bank were appropriate in 119 (94.4%) of the 126 cases where the guideline was followed. Blood was

ordered preoperatively in 83 of the 195 cases, but only used in 50 cases (60.2%). Of the 33 cases where blood was not used, 23 cases were not in keeping with the guideline. In 50 (83%) of the 60 cases where blood was ordered according to the guideline, it was appropriate. The performed surgery proceeded as planned in 162 (83.1%) cases.

Discussion: Blood transfusion exposes the recipient to transfusion-related risks and is expensive. In an attempt to avoid these risks there has been a trend towards conservative transfusion practices. It has been shown to be cost effective and safe to employ a restrictive transfusion practice during major paediatric burn surgery. During our study period one unit of blood cost R1096,00 and a group and screen R172,00. Significant savings could therefore be incurred if blood is ordered according to the proposed guideline.

Conclusion: This audit confirmed that the guideline is an appropriate one to use for preoperative ordering of blood products for burns surgery at the Red Cross War Memorial Children's Hospital.

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List of abbreviations

2, 3-DPG	2, 3-Diphosphoglycerate
ANH	Acute normovolemic haemodilution
CBL	Calculated blood loss
COD	Change of dressings
EBL	Estimated blood loss
EBV	Estimated blood volume
FFP	Fresh frozen plasma
G&S	Group and screen
Hb	Haemoglobin
HIV	Human immunodeficiency virus
ICU	Intensive care unit
RBC	Red blood cell
ROC	Removal of clips
ROTEM	Rotational thromboelastometry
RCWMCH	Red Cross War Memorial Children's Hospital
rFVIIa	Activated recombinant coagulation factor VII
SHS	Stabilised human serum
SSG	Split skin graft
TBSA	Total body surface area
TF	Tissue factor
TRALI	Transfusion related acute lung injury

Chapter 1: Introduction and Literature review

Introduction:

Major paediatric burn injury causes significant morbidity and mortality. In a resource constrained setting, the financial burden of these patients' care is also particularly significant. A burn wound involving more than 10% of total body surface area (TBSA) frequently changes haematological parameters and leads to anaemia.[1,2] This anaemia worsens during excision and grafting of burn wounds as it is often associated with major blood loss. The hypovolemia and anaemia suffered during such surgery puts burns patients at risk of complications such as decreased oxygen delivery, coagulation abnormalities and intravascular volume depletion. These patients therefore frequently require red blood cell (RBC) transfusion. Currently there are no clear guidelines on when to administer blood products to burn victims, but the overall trend is one of employing a more restrictive transfusion strategy so as to decrease transfusion related complications.[3]

In an effort to rationalise blood ordering practices and avoid wastage, various formulae have been suggested over the years.[2,4,5] In addition to this, numerous surgical techniques have been employed to decrease blood loss during surgery. These include, but are not confined to: early, planned excision and grafting of burn wounds,[6] topical application of adrenaline containing swabs with or without thrombin,[7] subcutaneous infiltration of vasoconstrictors at donor and/or graft site,[8] and maintaining euthermia.[9]

With all these new developments, older formulae have become inaccurate and outdated and it has become increasingly more difficult to accurately predict blood loss during burn surgery. The predicament has become one of containing cost by not ordering blood unnecessarily and/or excessively, versus putting a patient at risk by not having blood available when he or she needs it. The need to find the balance between cost-effective service and safe surgical practice, has become apparent.

Haematological derangements associated with burns:

The aetiology of anaemia in burn victims is multifactorial. Severe thermal injury causes the release of several inflammatory mediators resulting in a localised and systemic inflammatory response. This inflammatory response causes both localised and generalised capillary leak and oedema. This happens almost immediately following burn injury. The acute pathophysiology thus comprises an initial increased haematocrit and blood viscosity due to haemoconcentration. During resuscitation of these patients they develop anaemia as a consequence of haemodilution. Additional factors that worsen anaemia include haemolysis from heat-damaged erythrocytes, delayed and decreased erythropoiesis, ongoing blood loss at wound sites and from concomitant injuries, and iatrogenic causes (i.e. blood sampling).[1,5,9]

Depending on the burn size and extent, blood loss during surgery, and the presence of sepsis, a variety of clotting abnormalities can develop. During the acute phase after a massive burn, there is both a consumptive coagulopathy and a microangiopathic haemolytic process.[10] Platelet aggregation occurs at wound sites and damaged microvasculature. The response is a typical anti-inflammatory one with increased production of clotting factors, platelets and fibrinogen which leads to a hypercoagulable state 3-5 days post burn.[9,10] Despite this prothrombotic milieu, paediatric patients rarely develop thrombotic events. In contrast with the acute phase, with the onset of sepsis there is a sudden decrease in platelet count.[10]

Anaemia, thrombocytopenia and evidence of coagulopathy are thus common occurrences in patients with severe burns.

Estimation and prediction of blood loss (during burns surgery):

Major burn surgeries can be associated with large fluid losses due to insensible evaporative loss from exposed wounds as well as blood loss from wound debridement and donor sites. A number of factors influence this blood loss but it mostly correlates to site and area excised.[11,12] Due to the development of hyperaemia in burn wounds, blood loss during surgery will progressively increase from time of injury. Presence of infection increases blood loss.[9] Surgical technique also impacts on severity of bleeding. Tangential excision encompasses layered removal of necrotic tissue until a viable wound bed, as evidenced by capillary bleeding, is seen.[13] This leads to increased blood loss but often a better cosmetic result and improved quality of life for the patient. It is estimated that blood loss is 4ml/cm² with this technique compared to 1.5ml/cm² with fascial excision.[9]

Accurately assessing and preoperatively predicting this volume is difficult but doing so will reduce wastage of scarce resources whilst avoiding undue risk to the patient. It takes at least 45 minutes to crossmatch blood after a group and screen has been done. Thus, not ordering blood for a patient in advance could prove detrimental. Many clinicians err on the side of caution and order excessively preoperatively.[11] A study done by Brown et al at our institution, showed that 46% of the total blood cost during one year (1991), was spent on unutilised blood.[4]

Two of the methods used to measure blood loss are gravimetric analysis, and experience and observation.

<u>Gravimetric analysis:</u>

The first technique involves measuring volume directly by gravimetric analysis. All materials used during surgery are collected and weighed before and after the procedure.[11] Brown et al used this method to determine if using a formula preoperatively to predict intraoperative blood loss would be accurate. They prospectively evaluated 70 consecutive children undergoing 111 surgical procedures. The formula they used is:

Estimated blood loss (EBL) = (%Burn area + %donor area/32) x blood volume

Blood volume was calculated as being 80ml/kg and 32 was an empirical number used. Using linear regression they found a significant relationship using this formula with a correlation coefficient of R=0.99. It should be noted that no topical or subcutaneous vasoconstrictors were used. Bleeding was controlled with pressure or bipolar coagulation and ligation of larger vessels.[4] This method is clearly complicated and tedious, and is currently rarely used outside of research purposes.

<u>Experience and observation:</u>

The method that is probably used most frequently for estimation of intraoperative blood loss relies on the experience of surgical, anaesthetic and nursing staff involved in burns surgery. It relies on visual assessment of soaked swabs, drapes and suction canisters, and observation of cardiovascular parameters. Although it has been criticised for being inaccurate, this method is a recognised technique and has been used in research by different groups.[2,5,11]

Criswell and Gamelli conducted a retrospective chart review during which EBL was charted in this way, and derived a formula to predict the requirement for transfusion. They proposed that the formula be validated in a prospective trial. They looked at 107 adult patients with >20% TBSA burns undergoing 273 procedures. Blood conservation strategies employed were standardised in all patients and included: aggressive warming to maintain euthermia, saline or saline/adrenaline subeschar clysis prior to excision, tourniquets on all extremities where possible, and tangential excision immediately covered with adrenaline/thrombin or thrombin-only soaked gauze at donor and burn sites. The average EBL was 820ml per procedure. To maintain a postoperative haematocrit of 25-31%, they needed to transfuse a total of 1.78 units packed RBC per $1000cm^2$. As the volume of packed RBCs is not standardised, it is difficult to extrapolate this to ml/cm^2, but assuming the average volume is 285 ml/unit, it would mean that 0.51 ml/cm^2 would be needed to maintain this haematocrit. They proposed that it would be valuable to institute a blood ordering protocol based on extent of planned surgical excision.[5]

Formulas to determine blood loss are understandably flawed. Studies done consisted of heterogeneous populations and widely varying surgical techniques. Correction would need to be made for variables including: duration since injury, presence of sepsis and site of injury and surgical techniques. Establishing statistical analysis or significance is not possible.

Transfusion related complications:

<u>Infection risk:</u>

Due to dramatic improvements in practice, screening, and research, transfusion of blood products in the developed world has never been as safe as it is now. According to the American Medical Association the risk of contracting the human immunodeficiency virus is 1:1,800,000, Hepatitis B 1:220,000 and Hepatitis C 1:1,600,000. In combination with additional risks such as other bacterial or parasitic infection, ABO compatibility, and pulmonary dysfunction, the risk of developing an adverse reaction increases to 1:1000 – 1:10,000.[2,3,14]

Transfusion related immunomodulation:

Transfusion of blood components leads to impairment of macrophage migration and cell-mediated immunity, resulting in immunosuppression. This augments the risk for perioperative infection in burn and trauma patients.[1,2] In a multicentre study of transfusion among 666 burn victims with >20% TBSA burns, Palmieri et al showed that the risk of developing an infection increases with 13% per unit of blood transfused ($P < 0.001$).[15]

Storage lesion:

In order to have blood readily available, blood banks store RBC units for up to 42 days. After about 14 days, the RBC undergoes a number of biochemical and structural changes that can be potentially harmful. There is progressive accumulation of proinflammatory and biologically active substances in the storage medium. The erythrocyte becomes less pliable, loses its biconcave shape and aggregates in the microcirculation. 2,3-Diphosphoglycerate (2,3-DPG) levels decrease during storage, causing a left shift in the oxyhaemoglobin dissociation curve, thus increasing the erythrocytes' affinity for oxygen. The intracellular ATP levels decrease, which decreases the cell's ability to store and transport oxygen. All of these changes result in compromised oxygen delivery at tissues level.[3,16]

The outcomes data concerning storage lesion is conflicting. In a recent meta-analysis of eight randomised control trials, Ng et al demonstrated a statistically insignificant trend towards decreased mortality associated with prolonged packed RBC storage duration. This is in contrast to observational data in cardiac, intensive care unit (ICU), and trauma patients which linked increased RBC age to adverse clinical outcomes. These patients may represent patients with a more significant inflammatory response. They concluded that data is currently insufficient to change clinical practice. Most of these studies however do not refer to burns patients which makes drawing conclusions difficult.[17]

Cartotto et al did a single centre retrospective review over a ten year period in adult patients with >20% TBSA burn who received at least 1 unit of RBCs. Regression analysis revealed that the amount of blood, rather than the age, had the most important association with adverse outcome. The authors suggest a randomised controlled trial.[16]

Pulmonary complications:

Transfusion related acute lung injury (TRALI) typically presents within 4 hours after blood administration. The estimated incidence is 1 in 5000 transfusions and has a mortality of 5-10%. However, it is thought that this complication isn't always clinically recognised and that it may be underreported. Symptoms, caused by noncardiogenic pulmonary oedema, include hypotension, fever and dyspnoea. The mechanism of TRALI is not clearly understood but the increased permeability of the pulmonary vasculature is believed to be the result of localised antibody-coated leucocytes.[1]

Incompatibility errors:

Major haemolytic reaction due to ABO-incompatibility is the leading cause of transfusion related complications. It leads to pain, fever, chills, nausea and vomiting, hypotension, renal failure, and disseminated intravascular coagulopathy. This is nearly always due to human error and is responsible for half of deaths associated with transfusions.[1] Acute non-ABO haemolytic reactions and febrile non-haemolytic reactions are more common but are self-limiting in nature.

Cost:

During the study period one adult unit of RBC cost R1096,00 and a group and screen R172,00. Cross-matching blood when it is not needed could thus result in wastage of health care funds. Because blood can be reserved for a patient for 48 hours, unnecessarily ordering blood takes these units out of the general inventory and could potentially lead to wastage of valuable resources.

All of these factors have led to the development of techniques to minimise blood loss during surgery in an attempt to minimise or negate the need for blood transfusion.

Blood conservation strategies:

There are three pillars on which the concept of patient blood management rests. The first is optimising preoperative red cell mass and correcting anaemia. The second, reducing perioperative blood loss. And finally, to optimise transfusion practices and anaemia tolerance.[18]

Preoperative optimization:

Although preoperative optimisation is not possible in emergency situations, supplementation with folate and vitamin B12 should be considered in all burn patients in the perioperative period. This serves to optimise haematopoiesis. Belmonte et al showed that the hyposideraemia that is associated with the acute phase after burn injury usually resolves without iron supplementation,[19] and as a result of experimental evidence that iron supplementation in critically ill patients may increase the risk of free radical production and infection, it cannot be routinely recommended until further evidence in burn victims becomes available.[1]

Reduction of perioperative blood loss:

Timing of surgery:

Desai et al concluded in their review of 1662 paediatric burn patients that surgery within 24 hours or after 16 days, greatly reduced blood loss. They attributed this to high levels of vasoactive mediators, like thromboxane A2, present in the acute phase.[6] Ong et al conducted a systematic review of randomised control trials on the efficacy and safety of early burn wound excision. They showed a statistically significant reduction in mortality and length of hospital stay with early surgery. In contrast to Desai's observation, early excision in this review was associated with increased blood loss. Prompt excision has now become the standard of care in most burn centres. It is thought that there is less endotoxin production, bacteraemia and inflammatory mediator release. Which could reduce the incidence of sepsis and multi-organ failure.[7,20]

Adrenaline clysis:

Beausang et al prospectively analysed 29 paediatric patients with small to medium size burns (mean 4% TBSA) who required surgical debridement and skin grafting. They subcutaneously injected both graft donor sites and burn wounds with a solution of 1:500,000 adrenaline and bupivacaine. None of their patients required a transfusion and there were no systemic side effects reported. Graft success was 95% showing that graft survival was not compromised using this technique. Additionally, there was minimal postoperative oozing, which improved dressing changes, and decreased postoperative pain.[8]

Multiple conservation techniques:

Sheridan and Szyfelbein performed a retrospective review of blood conservation techniques in children with >10% TBSA burns. They looked at two 3 year intervals separated by a decade. Between these periods they instituted various methods of blood conservation which included: clear planned excision, using pneumatic tourniquets for all limb excisions, using electrocautery for all fascial excisions, expediting major excisions prior to development of wound hyperaemia, using subeschar adrenaline clysis, and maintaining euthermia. They found a statistically significant reduction in RBC and fresh frozen plasma (FFP) usage in all burn size categories as well as a significant reduction in children exposed to blood products.[21]

Similarly, Cartotto et al implemented a uniform protocol of blood conservation techniques and compared it with a historical control group. These included donor site and burn wound topical adrenaline and tumescence, and limb tourniquets. The historical group only had topical adrenaline and thrombin applied to all wounds. The calculated blood loss (CBL) as well as CBL per % excised was reduced by nearly 50%, and transfusions were decreased from 3.3 ± 3.1 units per case to 0.1 ± 0.3 units per case in the study group without compromising wound outcome.[7]

In another retrospective review between two groups before and after implementing a protocol of surgical techniques, O'Mara et al noted the most significant change occurred in patients with smaller burns (<20% TBSA).

They saw a drop in transfusion requirements from 1 in 3 patients, to 1 in 25 patients.[22]

Rational interventions:

Schaden et al designed a treatment algorithm based on rotational thromboelastometry (ROTEM®) testing during burns surgery. They prospectively compared blood product usage in 30 consecutive patients, with a control group. Significantly less allogeneic blood and plasma was transfused in the algorithm group. They suggest that it was the rational therapeutic intervention and not merely monitoring of coagulation that reduced transfusion requirements.[18]

Topical tranexamic acid:

Tranexamic acid is antifibrinolytic in that it competitively inhibits the activation of plasminogen, preventing plasmin formation. Plasmin is responsible for breakdown of fibrin clot and other procoagulant plasma proteins. Tang et al reported a case study in which he safely used 0.1% topical tranexamic acid to stop operative bleeding after failing to control it with 1:100,000 adrenaline soaked swabs and 10 minutes of applied pressure. The patient was a 58 year old man with 11% TBSA burns to the head and neck. They concluded that this is a method to consider where conventional methods to control haemorrhage fail.[23]

Activated recombinant factor VII:

Eriksen et al conducted a single centre, randomised, double blind, placebo controlled trial in 18 consecutive adults with >10% TBSA burn scheduled for full thickness burn wound excision and skin grafting. They hypothesised that activated recombinant coagulation factor VII (rFVIIa) would reduce blood transfusion requirements. rFVIIa enhances thrombin generation at the site of injury via tissue factor (TF)-dependant mechanisms. The study group received a 40μg/kg intravenous bolus immediately before surgery and again at 90 minutes. The total number of blood products in the study group was significantly lower than in the placebo group ($P = 0.0013$).[24]

Terlipressin:

In a similar study Mzezewa et al compared 20µg/kg terlipressin 30 minutes prior to, and 4 and 24 hours after surgery with placebo. Terlipressin is an analogue of vasopressin and is used as a vasoactive drug in the management of hypotension. Blood loss was on average 21% less and the need for transfusion was reduced by a factor of 2.5 in the study group without affecting graft survival.[25]

Acute normovolemic haemodilution:

Autologous transfusion of blood can be employed in three ways: predonated blood, intraoperative cell salvage, or acute normovolemic haemodilution (ANH). During burns surgery predonation is not feasible and due to the risk of bacterial contamination, cell salvage is not indicated. Blood loss whilst employing ANH seems to be similar to when it is not used, but actual loss of blood components is reduced. Although most of the studies evaluating ANH are performed in adults,[26] Copley et al showed that using this technique, transfusion could be reduced from 79% to 37% during adolescent spine surgery.[27] Imai et al reported on a case series of 7 consecutive burn patients with <20% TBSA and concluded that ANH might avoid or minimise the risk of allogeneic blood transfusion in these patients.[10,28]

Thermoregulation:

Maintaining euthermia is a strategy that is often overlooked. Mild hypothermia (<35ºC) causes platelet dysfunction and a mild decrease in platelet count, leading to increased bleeding risk. When temperatures drop below 33°C other steps in the coagulation cascade, such as the synthesis and kinetics of clotting enzymes and plasminogen activator inhibitors, can also be affected.[29] Patients with burns are particularly prone to developing hypothermia due to exposure during surgery, and large evaporative heat loss that occur from their wounds. Anaesthesia in itself inhibits the physiological thermoregulatory mechanism, putting the patient at further risk for hypothermia. The extent of heat loss is related to operating room temperature and TBSA of the burn wounds. The aim should be to maintain the patients' body temperature close to 37ºC. Ways to maintain euthermia include: warming of operating rooms to decrease the temperature gradient from body to environment, use of warmed fluids to wash patients and drying them promptly afterwards, covering body areas not to be worked on, use of forced air warmers or overhead air warmers where applicable, warming all intravenous fluids and blood products given and using humidified inspired anaesthetic gases.[1]

Minimising iatrogenic losses:

Iatrogenic blood loss via repeated phlebotomy can be minimised by using paediatric sample tubes, batching tests within a single sample, and obtaining laboratory results only when clinically indicated.[1]

Optimising transfusion practices:

Traditionally blood has been transfused when haemoglobin levels fell below 10g/dl or the haematocrit dropped below 30%. Several older multicentre trials have shown that a more restrictive approach is not only safe, but is associated with a lower in-hospital mortality, cardiac complication rate, and incidence of organ dysfunction.[30,31]

Palmieri et al conducted a retrospective chart and database review in 2005 to compare outcomes of a restrictive policy (Hb < 7g/dl) with a traditional policy (Hb < 10g/dl) in children for major burn surgery. They reviewed two different 18 month periods, the first during which a traditional strategy was employed, followed by the restrictive strategy group with a six month transitioning period in between whilst the restrictive approach was being adopted. Surgical technique remained the same. Blood conservation techniques included lactated ringers/adrenaline tumescence and limb tourniquet use. The groups were comparable in terms of size, demographical data, TBSA of burn injury and presence of inhalational injury. The traditional group received more blood than the restrictive group ($P < 0.001$), their pre-transfusion and post-transfusion haemoglobins were higher ($P < 0.001$), and they received more mean number of units per patient as well as more blood per percentage TBSA burn. The restrictive group had fewer complications ($P < 0.05$). Cost in the restrictive group was cut nearly in half and they had half the incidence of pulmonary complications. The group suggested that a restrictive transfusion policy was safe and cost effective to introduce in children with burn injuries.[32]

The ideal transfusion trigger in children is not yet to known. Every transfusion of blood products should be tailored to the individual patient's clinical status and scenario, taking into consideration the haemodynamic status, duration of and physiological compensation for anaemia, and the risk of ongoing blood loss and potential surgery.

Conclusion:

Surgery for burn wounds can often be associated with significant blood loss which may require blood transfusion. Blood products are not only costly, but can expose the patient to any of a number of complications associated with transfusion.

There has been a general trend towards more conservative transfusion strategies. In addition to this change in practice, surgical techniques have evolved and the development of blood conservation strategies has led to a decreased need for transfusion of blood products.

In the burns theatre at the Red Cross War Memorial Children's Hospital, many of these strategies have been implemented, resulting in reduction of intraoperative blood loss. The need to have blood products available for a patient going to theatre has therefore also changed. Through collaboration of surgeons and anaesthetists, a guideline, based on expert opinion, was drawn up to guide the ordering of blood preoperatively. This guideline takes into account the patients' planned extent of surgery and baseline clinical status. The aim of our audit was to ascertain whether this guideline is appropriate in our setting.

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Chapter 2: Publication-ready Manuscript

AUDIT OF TRANSFUSION REQUIREMENTS FOR BURNS SURGERY

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Keywords: burns surgery, paediatric, blood loss, transfusion guideline, blood conservation.

Abstract:

Background: Major burn surgery can be associated with significant blood loss and transfusion of blood products. In an effort to decrease aforementioned blood loss, various blood conservation strategies have been developed, rendering formulae to predict blood loss outdated. Currently there are no guidelines on when to transfuse burn victims, but the trend is towards more conservative management. The predicament has become one of containing cost, versus putting patients at risk by not having blood available. A guideline was drawn up at the Red Cross War Memorial Children's Hospital in an effort to rationalise preoperative blood ordering. The aim of this audit was to assess how well the implemented guideline was adhered to, and how accurately the guideline predicted the need to have blood products available in theatre during burns surgeries of varying extent.

Methods: A prospective audit of practice was conducted. We included 200 separate, elective burn cases. Demographic data was collected preoperatively and data sheets completed intraoperatively. Ordering of blood was compared to the recommendations on the guideline and assessment was made on how often ordered blood was used. Since surgical extent impacts on blood loss, we assessed how often the surgical plan was adhered to.

Results: Blood was ordered according to the guideline in 131 (67.2%) of 195 eligible cases. The guideline was appropriate in 119 (94.4%) cases. The performed surgery was as planned in 162 (83.1%) cases.

Conclusion: This guideline is appropriate to use for preoperative ordering of blood products for burns surgery at the RCWMCH.

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Introduction:

Burns surgery can be associated with significant blood loss, often requiring blood transfusion. At the Red Cross War Memorial Children's Hospital, we have instituted several blood conservation techniques over the years. These include, covering donor areas and debrided wounds with adrenaline soaked swabs, subcutaneous injection of clysis (2mcg/ml adrenaline and 0.01% bupivacaine in isotonic crystalloid to decrease bleeding and pain), expediting surgery, using pneumatic tourniquets for limb surgery, and maintaining euthermia. Due to the efficacy of these measures, old formulae derived to predict intraoperative blood loss are no longer relevant. It has become very difficult to accurately predict the magnitude of blood loss and the need to order blood for a burns procedure.

The predicament has become one of containing cost by not ordering blood, versus exposing a patient to risk by not having blood available in the operating room when he or she needs it. In an effort to find the balance between cost-effective service and safe surgery, experienced burns anaesthetists and surgeons at the RCWMCH, collaborated to draw up a guideline for ordering of blood for theatre (table I). This guideline is based on preoperative haemoglobin (Hb), total body surface area to be operated (TBSA) on, and procedure to be done. It therefore takes into account the baseline status of the patient, and the expected extent of surgery.

After implementation of the guideline, we conducted an audit of transfusion practice with the aim to establish:

1. Adherence –whether blood gets ordered according to the guideline .
2. Accuracy –whether the guideline is appropriate (i.e. blood is available timeously when needed whilst unnecessary expenditure through excessive ordering of blood is avoided).

We also recorded how often the extent of the surgery performed was in keeping with the initial plan. This would impact on the amount of blood loss expected and the validity of the guideline, since it is based on planned extent of surgery. Any adverse events related to transfusion and blood loss were planned to be recorded.

Table I: Guideline for preoperative ordering of blood

Preoperative Hb	% TBSA to be worked on			
	> 10%	5 – 9%	< 5%	COD/ROC*
> 10 g/dl	1 packed cells	G&S†	-	-
8 – 9.9 g/dl	1 packed cells	1 packed cells	G&S	-
< 8 g/dl	1-2 packed cells	1 packed cells	1 packed cells	-
Any septic/scalp wounds	1-2 packed cells	1 packed cells	G&S	
If the area to be worked on is >30% (e.g. graft to 15%) be prepared to lose 1 x EBV				

* Change of dressings/removal of clips
† Group and screen

Methods:

Since the guideline is only based on expert opinion, we did a prospective audit of practice that ran from April 2014 to June 2015. No power analysis was done prior to commencement as this was merely an audit.

<u>Patient selection:</u>

The aim was to include 200 consecutive burn cases in the audit. All children coming for elective burns surgery were eligible for inclusion. Due to work load after hours, emergency cases were excluded. If children needed to come for follow-up surgery, additional data sheets were collected as it was considered a separate procedure.

<u>Consent:</u>

Informed consent was obtained by either the anaesthetist allocated to burns theatre, or the surgeon. It was taken during the preoperative consultation on the day before surgery. This was done in English, Afrikaans or isiXhosa according to the parent/guardian's preference. If needed, an interpreter was used to assist in this process (appendix 2 – 4). It was emphasised that whether or not the parent/guardian chose to participate in the study, clinical treatment of the child would not be affected in any way.

Data collection:

Basic demographic data was collected at the preoperative consultation. This included the patient's age, weight, preoperative haemoglobin concentration, planned extent of the surgical procedure, and whether there were any instructions by the surgeons to the blood bank (i.e. group and screen only, or packed cells ordered). Data was captured on a data sheet which accompanied the patient to theatre the following day (appendix 2).

The following data was collected intraoperatively on the same data sheet by the anaesthetist: type and volume of fluid administered, actual extent of surgery performed (% TBSA donor site and % TBSA burn wound debrided), method of debridement used, presence of sepsis in wounds, lowest and last haemoglobin measured by point of care HemoCue® devices, and whether there were any further instructions to the blood bank.

Results:

Of the 200 data sheets collected, 5 had to be excluded because the forms were incomplete, leaving 195 eligible cases. The average age of the included population was 3 years and 7 months. The average weight of the patients was 15.2kg and the average preoperative haemoglobin concentration was 11.3 g/dl. The majority of procedures done (174) were either split skin grafts, debridements, or a combination thereof. The remaining cases were change of dressings only in 14, and removal of clips in 7 cases. Although the numbers done compare well with the numbers of procedures planned (182 grafts and debridements, 6 change of dressings and 6 removal of clips), there were a few instances where the procedure done and the percentage body surface area involved in surgery, was less than planned or more than planned.

Adherence to guideline:

Blood was ordered according to the guideline in 131 (67.2%) of the 195 cases.

Table II shows the different groups as outlined in the guideline. The number of cases in each group is indicated, as well as the percentages of instances where the guideline was followed.

Table II: Guideline followed

Preoperative Hb	% TBSA to be worked on		
	>10%	**5 – 9%**	**<5%**
> 10g/dl	Group A 86.3% (n= 22)	Group B **4.8%** (n = 21)	Group C 82.2% (n = 107)
8 – 9.9 g/dl	Group D 88.9% (n = 9)	Group E 77.8% (n = 9)	Group F **17.4%** (n = 23)
<8 g/dl	Group G 100% (n = 1)	Group H 100% (n=2)	Group I 100% (n=1)

The two groups with poorest adherence to the guideline (groups B and F) are the groups where only a group and screen (G&S) was required. In Group B non-adherence was due to more liberal blood transfusion practices: blood had been ordered for 17 of the 21 patients. Eight of these patients received transfusions, of which 4 had more extensive surgery than initially planned. In Group F non-adherence was more balanced. Eight of the 23 patients had no instruction to blood bank (no G&S done), while 11 had blood ordered. Six of these 11 patients were transfused perioperatively.

Table III only includes cases where the guideline was followed correctly. It demonstrates the percentages for these cases in each area where the guideline was appropriate.

Table III: Guideline appropriate

Preoperative Hb	% TBSA to be worked on		
	>10%	**5 – 9%**	**<5%**
> 10g/dl	Group A 78.9% (n= 19)	Group B Excluded	Group C 100% (n = 88)
8 – 9.9 g/dl	Group D 62.5 (n = 8)	Group E 100% (n = 7)	Group F Excluded
<8 g/dl	Group G 100% (n = 1)	Group H 100% (n=2)	Group I 100% (n=1)

After excluding groups B and F, of the remaining 126 cases where the guideline was followed, it was appropriate and sufficient in 119(94.4%) cases.

The performed surgery was as planned in 162 (83.1%) of the cases.

No complications of transfusion, hypovolaemia or anaemia were recorded.

Discussion:

Analysis of different groups:

In group A the guideline was appropriate in 19 of the 22 patients. This group contained three patients who required large cadaver allografts with simultaneous debridement. One of these patients required blood whilst the other two did not, possibly suggesting that patients who need cadaver grafts should be considered in a separate group. In two other cases the extent of surgery was less than initially planned. This resulted that the ordered blood was not needed intraoperatively.

In group B the guideline required that a group and screen only be sent to blood bank. The guideline was adhered to in only 1 of the 21 patients. In 3 patients there were no G&S done and no packed cells were ordered pre-operatively. Packed cells were ordered preoperatively in 17 cases where, according to the guideline, a G&S alone would be advised. Only 8 of the aforementioned 21 patients were eventually transfused, in one of whom the surgery performed was more extensive than initially planned. This leaves 9 instances where blood ordered preoperatively was not used. Doing a G&S only implies that the risk for transfusion is such that the patient would not be put at risk by having to wait for 45 minutes for a full crossmatch to be done. The transfusion rate of 38% in this group and the absence of complications recorded indicate that a G&S alone would be appropriate.

The bulk of cases fell into group C. This group consisted of 107 cases in which the guideline suggested no orders to the blood bank. Of the 19 patients where the guideline wasn't followed, blood was ordered for 6 patients and a G&S was done for 13 patients. None of the units of blood ordered pre-operatively were used, and only one G&S was used to order blood. Two more patients who had had no instruction to blood bank needed to be transfused. This group thus demonstrates that for small burn areas and higher haemoglobin levels, it is wasteful to either G&S or pre-order blood.

Group D consisted of 9 patients for whom one unit of blood should be ordered according to the guideline. Of these the actual surgery done was less than planned in 6 instances, which makes it difficult to draw conclusions. The remaining three patients all required intraoperative blood transfusion.

Group E also consisted of 9 patients. All these patients required blood transfusion during surgery which lines up with the proposed guideline.

Group F, like group B, only required a preoperative G&S. Adherence to the guideline was again poor with clinicians erring on the side of caution by ordering blood to be available in theatre. In this group 6 of the 23 patients (26%) needed transfusions intraoperatively. As in group B, a G&S would give the anaesthetist enough time to order fully crossmatched blood when needed. This would confirm that the guideline can be confidently followed.

Groups D, E, G, H and I are more straightforward in that anaemic patients with larger %TBSA burns usually require transfusion.

If this guideline leads to a change in practice, Groups B and F would be the type of patient that it would influence. Both these groups fall in an area of uncertainty with regards to blood requirements, but it has been demonstrated in this audit that a G&S would be sufficient. The poor adherence in these groups most likely reflects clinicians' inclination to err on the side of caution.

Potential cost savings:

In 33 of 83 cases where blood was ordered preoperatively, it was not used. That equates to 39.8%. Of these 33, 23 cases were not in keeping with the guideline, which means that 83% of cases where blood was ordered according to the guideline, it was appropriate. Of the 10 cases in which the protocol was followed appropriately, the surgical procedure was less than planned in 6 instances, which might mean that blood loss was less than anticipated by the planned procedure.

During the study period a unit of blood cost R1096,00 and a G&S R172,00. Significant savings could therefore be incurred if blood is ordered appropriately. In this case R36168.00 was spent unnecessarily.

Major paediatric burn injury is known to remain a significant source of morbidity and mortality to the patient, their family, and health care personnel who care for these patients. This is even more pronounced in resource poor areas in the developing world.

Factors affecting blood loss:

Surgery for major burn can be associated with large fluid losses due to insensible evaporative loss from exposed wounds as well as blood loss from wound debridement and donor site. A number of factors influence this blood loss but it mostly correlates to the site of the burn and the area being excised.[1,2] The presence of infection will increase haemorrhage and due to the development of hyperaemia in wound beds, blood loss during surgery will progressively increase from time of injury.[3] In fact, Desai et al concluded in their review of 1662 paediatric burn patients that surgery within 24 hours or after 16 days, greatly reduced blood loss.[4] Ong et al conducted a systematic review of randomised control trials on the efficacy and safety of early burn wound excision. They showed a statistically significant reduction in mortality and length of hospital stay with early surgery. In contrast to Desai's observation, early excision in this review was associated with increased blood loss. Prompt excision has now become the standard of care in most burn centres. It is thought that there is less endotoxin production, bacteraemia and inflammatory mediator release which reduces the incidence of sepsis and multi-organ failure.[5,6]

Surgical technique also impacts on severity of bleeding. Tangential excision, as is done at our institution, encompasses layered removal of necrotic tissue until a viable wound bed, as evidenced by capillary bleeding, is seen.[7] This leads to increased blood loss but often a better cosmetic result and improved quality of life for the patient. It is estimated that blood loss is 4ml/cm² with this technique compared to 1.5ml/cm² with fascial excision.[3]

Accurately assessing and preoperatively predicting this volume is difficult but doing so will reduce wastage of scarce resources whilst avoiding undue risk to the patient. A study done by Brown et al at our institution, showed that 46% of total blood cost during one year (1991) was spent on unutilised blood.[8]

<u>Adverse effects of blood transfusion:</u>

Transfusion of blood is not without risk and is associated with a number of well recognised complications. The most feared is the contraction of blood borne viral infections. Chief amongst which is the human immunodeficiency virus (HIV). Despite this fear, the transfusion of blood products has never been as safe as it is now. Advances in technology, research and screening practices have reduced the risk of contracting HIV to around 1:1,800,000.[9]

Blood transfusions lead to impairment of macrophage migration and cell-mediated immunity, resulting in transfusion related immunomodulation. This augments the risk for perioperative infection in burn and trauma patients.[10,11] Palmieri et al showed that the risk of developing an infection increases by 13% per unit of blood transfused ($P < 0.0010$).[12]

In order to have blood readily available, blood banks store RBC units for up to 42 days. After about 14 days, the RBC undergoes a number of biochemical and structural changes that can potentially be harmful. There is progressive accumulation of proinflammatory and biologically active substances in the storage medium. The erythrocyte becomes less pliable, loses its biconcave shape and aggregates in the microcirculation. 2, 3-Diphosphoglycerate (2, 3-DPG) levels decrease during storage causing a left shift in the oxyhaemoglobin dissociation curve, thus increasing the erythrocytes' affinity for oxygen. The intracellular ATP levels decrease which decreases the cell's ability to store and transport oxygen. All of these changes result in compromised oxygen delivery to the tissues.[13,14] Cartotto et al did a single centre retrospective review over a ten year period in adult patients with >20% TBSA burn who received at least 1 unit of RBCs. Regression analysis revealed that the amount of blood rather than the age had the most important association with adverse outcome.[14]

The outcomes data concerning storage lesion is conflicting. In a recent meta-analysis of eight randomised control trials, Ng et al demonstrated a statistically insignificant trend towards decreased mortality associated with prolonged packed RBC storage duration. This is in contrast to observational data in cardiac, intensive care unit (ICU), and trauma patients which linked increased RBC age to adverse clinical outcomes. These patients may represent patients with a more significant inflammatory response. They concluded that data is currently insufficient to change clinical practice. Most of these studies however do not refer to burns patients which makes drawing conclusions difficult.[15] Cartotto et al did a single centre retrospective review over a ten year period in adult patients with >20% TBSA burn who received at least 1 unit of RBCs. Regression analysis revealed that the amount of blood, rather than the age, had the most important association with adverse outcome. The authors suggest a randomised controlled trial.

Transfusion related acute lung injury (TRALI) has an estimated incidence of 1 in 5000 transfusion. The mortality of this often overlooked condition is 5 – 10%. Although the mechanism is not clearly understood it is believed to be due to localisation of antibody-coated leucocytes to the pulmonary vasculature, leading to increased permeability thereof and development of pulmonary oedema.[10]

The leading cause of transfusion related complications is nearly always due to human error. Major haemolytic reaction due to ABO-incompatibility is responsible for half of deaths associated with transfusions.[10]

<u>Strategies aimed at transfusion avoidance:</u>

In an attempt to avoid all these complications a number of blood conversation strategies have been developed. These strategies rest on three pillars: preoperative optimisation of red cell mass, reducing intraoperative blood loss, and optimising transfusion practices and anaemia tolerance.[16]

Although preoperative optimisation is not possible in emergency situations, supplementation with folate and vitamin B12 should be considered in all burn patients in the perioperative period. This serves to optimise haematopoiesis.[10]

Beausang et al prospectively analysed 29 paediatric patients with small to medium size burns (mean 4% TBSA) who required surgical debridement and skin grafting. They subcutaneously injected both graft donor sites and burn wounds with a solution of 1:500,000 adrenaline and bupivacaine. None of their patients required a transfusion and there were no systemic side effects reported. Graft success was 95% showing that graft survival was not compromised using this technique.[17] Additionally, there was minimal postoperative oozing, which improved dressing changes, and decrease of postoperative pain. Clysis, as described by Beausang et al, is employed liberally at our institution, contributing to the fact that our guideline only requires blood to be crossmatched if surgery is done to a TBSA <5% in patietnts with a Hb <8g/dl.

Maintaining euthermia is a strategy that is often overlooked. Mild hypothermia (<35ºC) causes platelet dysfunction and a mild decrease in platelet count, leading to increased bleeding risk. When temperatures drop below 33°C other steps in the coagulation cascade, such as the synthesis and kinetics of clotting enzymes and plasminogen activator inhibitors, can also be affected.[18] Patients with burns are particularly prone to developing hypothermia due to exposure during surgery, and large evaporative heat loss that occur from their wounds. Anaesthesia in itself inhibits the physiological thermoregulatory mechanism putting the patient further at risk for hypothermia. The extent of heat loss is related to operating room temperature and TBSA of the burn wounds. The aim should be to maintain the patients' body temperature close to 37ºC.[10]

Sheridan et al performed a retrospective review of blood conservation techniques in children with >10% TBSA burns. They looked at two 3 year intervals separated by a decade. Between these periods they instituted various methods of blood conservation which included: clear planned excision, using pneumatic tourniquets for all limb excisions, using electrocautery for all fascial excisions, expediting major excisions prior to development of wound hyperaemia, using subeschar adrenaline clysis, and maintaining euthermia. They found a statistically significant reduction in RBC and fresh frozen plasma (FFP) usage in all burn size categories.[19]

In another retrospective review between two groups before and after implementing a protocol of surgical techniques, O'Mara et al noted the most significant change occurred in patients with smaller burns (<20% TBSA). They saw a drop in transfusion requirements from 1 in 3 patients, to 1 in 25 patients.[20]

Autologous transfusion of blood can be employed in three ways: predonated blood, intraoperative cell salvage, or acute normovolemic haemodilution (ANH). During burns surgery predonation is not feasible and due to the risk of bacterial contamination, cell salvage is not indicated. Although most of the studies evaluating ANH are performed in adults,[21] Copley et al showed that using this technique, transfusion could be reduced from 79% to 37% during adolescent spine surgery.[22] Imai et al reported on a case series of 7 consecutive burn patients with <20% TBSA and concluded that ANH might avoid or minimise the risk of allogeneic blood transfusion.[23,24] ANH is rarely employed at our institution due to lack of sufficient evidence in children.

Traditionally blood has been transfused when haemoglobin levels fell below 10g/dl or the haematocrit dropped below 30%. Several multicentre trials have shown that a more restrictive approach is not only safe, but is associated with a lower in-hospital mortality, cardiac complication rate, and organ dysfunction.[25,26]

Perhaps the most important study in this field was done by Palmieri et al. They conducted a retrospective chart and database review to compare outcomes of a restrictive policy (Hb < 7g/dl) with a traditional policy (Hb < 10g/dl) in children for major burn surgery. They reviewed two different 18 month periods, the first during which a traditional strategy was employed, followed by the restrictive strategy group with a six month transitioning period in between whilst the restrictive approach was being adopted. Surgical technique remained the same. Blood conservation techniques included lactated ringers/adrenaline tumescence and limb tourniquet use. The groups were comparable in terms of size, demographical data, TBSA of burn injury and presence of inhalational injury. The traditional group received more blood than the restrictive group ($P < 0.001$), their pre-transfusion and post-transfusion haemoglobins were higher ($P < 0.001$), and they received more mean number of units per patient as well as more blood per TBSA burn. The restrictive group had fewer complications ($P < 0.05$). Cost in the restrictive group was cut nearly in half and they had half the incidence of pulmonary complications. The group suggested that a restrictive transfusion policy was safe and cost effective to introduce in children with burn injuries.[27]

Measures taken to reduce blood loss during surgery at RCWMCH include: maintaining euthermia, adrenaline and bupivacaine clysis injection, adrenaline soaked swabs, electrocautery use when necessary, employing restrictive transfusion practices and early burns surgery.

The ideal transfusion trigger in children is not yet known. Every transfusion of blood products should be tailored to the individual patient's clinical status and scenario, taking into consideration the haemodynamic status, duration of and physiological compensation for anaemia, and the risk of ongoing blood loss and potential surgery. This is why a guideline would be a more appropriate tool than a set protocol.

Limitations:

There were a number of limitations to this study. The guideline was merely a suggestion and adherence was not enforced. Although our unit uses a haemoglobin of 7 g/dl as transfusion trigger, this is not enforced either.

Clinicians therefore were able to follow more liberal blood ordering and transfusion practices than suggested, which may have influenced our data.

No data was collected after patients left the theatre complex. Ideally the continued changes in haemoglobin should have been followed for 24 hours, as fluid shifts may still happen postoperatively. We were therefore unable to accurately assess complications associated with anaemia or transfusion related complications.

Conclusion:

The aim of this audit was to establish whether a preoperative guideline for ordering blood during burns surgery in children was appropriate.

We conclude that, at the Red Cross War Memorial Children’s Hospital, this guideline is indeed appropriate.

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Appendix 1

Table I: Guideline for preoperative ordering of blood

Preoperative Hb	**% TBSA to be worked on**			
	> 10%	**5 – 9%**	**< 5%**	**COD/ROC ***
> 10 g/dl	1 packed cells	G&S[†]	-	-
8 – 9.9 g/dl	1 packed cells	1 packed cells	G&S	-
< 8 g/dl	1-2 packed cells	1 packed cells	1 packed cells	-
Any septic/scalp wounds	1-2 packed cells	1 packed cells	G&S	
If the area to be worked on is >30% (e.g. graft to 15%) be prepared to lose 1 x EBV				

* Change of dressings/removal of clips

[†] Group and screen

Appendix 2

PATIENT DEMOGRAPHICS:		**DATE BOOKED FOR:**	
NAME:			
DATE OF BIRTH:	YYYY MM DD	AGE:	
WEIGHT:	kg		
PRE-OPERATIVE INFORMATION AND PLAN:			
HB:			
PROCEDURE PLANNED: (tick)		AREAS INVOLVED: (e.g. arm, scalp)	
SSG (Split skin graft)			
Debridement			
COD (Change of dressing)			
ROC (removal of clips)			
Other (specify)			
PERCENTAGE BODY SURFACE AREA:	(to be worked on)		
BLOOD BANK INSTRUCTION:			
None			
G&S (Group and screen)			
Packed cells - no. of units			
Whole blood - no. of units			
Other (specify)			
INTRA-OPERATIVE INFORMATION:			
FLUID AND BLOOD ADMINISTERED:		**UTILIZATION OF, AND ORDERING BLOOD:**	
Ringers Lactate (ml)			
Voluven (ml)		**ADDITIONAL** BLOOD BANK INSTRUCTION:	
SHS (ml)		G&S sent	
Packed cells (ml)		Packed cells ordered	(no.)
Whole blood (ml)		Whole blood ordered	(no.)
Clysis (ml)		Other (specify)	
Other (specify)			
PROCEDURE PERFORMED:		WOUND SEPTIC	Y / N
SSG (percentage area)			
Debridement only (% area)		DEBRIDED WITH:	Humby
COD			Versajet
ROC			Other
Other (specify)			
		SUMMARY: (tick)	
LOWEST HB:	(if measured)		
		PROCEDURE DONE WAS:	
LAST HB:		As planned	
		Less than planned	
POST-OPERATIVE INFORMATION:		More than planned	
ONGOING TRANSFUSION (ml)		BLOOD OREDERED APPROPRIATELY?:	
TRANSFUSION INITIATED (ml given)		G&S not used	
LOWEST HB MEASURED OVER 24 HRS		G&S used to order blood	
LAST HB MEASURED WITHIN 24 HRS		Incompletely crossmatched blood used	
		Blood oredered pre-op. not used	
ANY COMPLICATIONS:		Blood ordered pre-op. used	

Appendix 3

INFORMATION AND CONSENT

AUDIT OF TRANSFUSION REQUIREMENTS FOR BURNS SURGERY

Thank you for your participation in this audit.

Children going to theatre to have operations for burn injuries, may loose a significant amount of blood, and may need blood transfusions. Since it takes time to test and prepare blood that will be given to a patient, we have to plan beforehand and order blood if we think we might need it. We have a way of deciding who we think might need blood, but we want to test our method, and make sure we do not order too much or too little blood.

We want to assess what happens to our burn injured patients that go to theatre over a period of 4 to 6 months. This audit will not change the way we treat your child. We only want to record what we do: We will record what your child's blood count (haemoglobin) is before surgery (as we always do), record what operation he/she has, whether he/she gets a blood transfusion, and record what his/her blood count is afterwards.

All information about your child will be managed in a confidential manner.

Should you decide not to take part in the audit, your child will still receive the same high quality of care that he/she would have received otherwise.

Consent:

(Hospital sticker)
Patient name:____

Hospital number:____

Date of birth:____

I, ____hereby give consent that my child be included in the audit of blood transfusion requirements for burns surgery. I have been fully informed about the implications, and I am satisfied that all my questions have been answered.

Signature: ____

Capacity (circle): Father Mother Legal guardian

Date:____

Doctor taking consent:____

Signature:____

For more information, contact any of the doctors doing the audit:

Dr. Kotie Bester	Dr. Roux Martinez	Prof. Jenny Thomas
Anaesthesia, theatre	Burns surgery, ward C2	Anaesthesia, theatre
Extension 5105 / 5003	Extension 5055 / 5155	Extension 5105 / 5003

Appendix 4

INLIGTING EN TOESTEMMING

OUDIT VAN BLOEDOORTAPPINGS VIR PASIËNTE WAT CHIRURGIE KRY VIR BRANDWONDE

Dankie vir u deelname aan hierdie oudit.

Kinders wat teater toe gaan vir operasies vir brandwonde, kan soms heelwat bloed verloor en 'n bloedoortapping nodig hê. Aangesien dit tyd neem om toetse en voorbereiding te doen vir 'n bloedoortapping, moet ons vooruit beplan en bloed bestel as ons dink dat ons dit mag nodig hê in die teater. Ons het 'n manier om te besluit watter kind ons dink bloed gaan nodig hê, maar ons wil graag ons metode toets, en seker maak dat ons nie te min of te veel bloed bestel nie.

Ons gaan oor 'n tydperk van 4 tot 6 maande kyk na ons pasiënte wat teater toegaan vir brandwonde. Hierdie oudit sal glad nie die manier waarop ons u kind behandel, verander nie. Ons wil net sien wat met u kind gebeur: Ons sal aanteken wat u kind se bloedtelling (hemoglobien) is voor hy/sy teater toe gaan, soos ons altyd doen. Dan sal ons aanteken watter operasie hy/sy kry, of hy/sy 'n bloedoortapping kry, en sien wat sy/ haar bloedtelling na die operasie is.

Alle informasie omtrent u kind sal op 'n vertroulike manier hanteer word.

As u sou besluit om nie aan die oudit deel te neem nie, sal u kind steeds dieselfde hoë kwaliteit sorg kry as wat hy/sy gewoonlik sou kry.

Toestemming:

(Hospitaal plakker)
Pasiënt se naam:______________________________

Hospitaal nommer:______________________________

Geboorte datum:______________________________

Ek, ______________________________gee hiermee toestemming dat my kind ingesluit word by die oudit van bloedoortappings vir pasiënte wat chirurgie kry vir brandwonde. Ek is ten volle ingelig oor wat dit behels, en ek is tevrede dat al my vrae beantwoord is.

Handtekening: ______________________________

Rol (omkring): Vader Moeder Wettige voog

Datum:______________________________

Dokter wat toestemming neem:______________________________

Handtekening:______________________________

Vir meer inligting, kontak enige van die dokters wat die oudit doen:

Dr. Kotie Bester Narkose, teater Uitbreiding 5105 / 5003	Dr. Roux Martinez Brandwonde chirurgie, saal C2 Uitbreiding 5055 / 5155	Prof. Jenny Thomas Narkose, teater Uitbreiding 5105 / 5003

Appendix 5

IINKCUKACHA NEMVUNE

IZINTO EZIYIMFUNEKO XA KUSENZIWA UVAVANYO LOKUTHIWA KWEGAZI KWISIGULANE ESITSHILEYO

Siyabulela ngokuthatha kwakho inxaxheba kolu vavanyo.

Abantwana abasiwa ethiyetha beyokwenziwa utyando lwamanxeba okutsha, bangalahlekelwa ligazi elininzi, kwaye ingakhona imfuneko yokuthiwa kwegazi. Noxa nje kuthatha ixesha ukwenza uvavanyo nokulungisa igazi eliya kuthi lithiwe kwisigulane, kufuneka senze amalungiselelo kuselithuba ukuba kuza kubakho imfuneko yoko. Sinendlela yokubona ukuba ngubani ekufuneka ethiwe igazi, kodwa ke sifuna ukuvavanya le ndlela yethu, ukuze siqinisekise ukuba asi-odoli igazi elininzi okanye elincinci.

Sifuna ukujonga ukuba kwenzeka ntoni kwizigulane zethu ezitshileyo ezisiwe ethiyetha isithuba seenyanga ezi-4 ukuya kwezi-6 . Olu vavanyo aluyi kutshintsha indlela esiya kuthi simphathe ngayo umntwana wakho. Sifuna ukubhala le nto siyenzayo: Siya kubhala phantsi iiseli zegazi (haemoglobin) lomntwana wakho ngaphambi kotyando (njengoko sihlala sisenza), sibhale phantsi ukuba loluphi utyando awakha walwenziwa, ingaba uza kuthiwa igazi, uze ubhale phantsi iiseli zegazi emva koko.

Zonke iinkcukacha ngomntwana wakho ziya kuba yimfihlo.

Ukuba uthatha isigqibo sokuba ungathathi nxaxheba kolu vavanyo, akukho tshintsho kwimpatho yomntwana wakho uya kufumana inkathalo efanelekileyo njengabanye abantwana.

Imvume:

(Istika sesibhedlele)
Igama lesigulane: ______________________________

Inombolo yesibhedlele: ______________________________

Date of birth: ______________________________

Mna, ______________________ ndiyavuma ukuba umntwana wam afakwe kolu vavanyo lwenziwa kubantwana abatshileyo abaza kutyandwa. Ndazisiwe malunga nako konke, kwaye ndanelisekile kuba imibuzo yam yonke iphendulwe.

Kutyikitya: ______________________________

Ofanelekileyo (rhangqa): Utata Umama Umzali wasemthethweni

Umhla: ______________________________

Ugqirha othatha imvume: ______________________________

Kutyikitya: ______________________________

Ngeenkcukacha ezithe vetshe, unganxulumana naye nawuphi na igqirha owenza uvavanyo lwegazi:

UGqr. Kotie Bester Anaesthesia, theatre Extension 5105 / 5003	UGqr. Roux Martinez Burns surgery, ward C2 Extension 5055 / 5155	UProf. Jenny Thomas Anaesthesia, theatre Extension 5105 / 5003

Appendix 6

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Faculty of Health Sciences Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
e-mail: sumayah.ariefdien@uct.ac.za
www.health.uct.ac.za/research/humanethics/forms

29 August 2013

HREC REF: 550/2012

Dr K Bester
Department of Anaesthesia
D-Floor
Red Cross War Memorial Children's Hospital
Rondebosch

Dear Dr Bester

PROJECT TITLE: AUDIT OF TRANSFUSION REQUIREMENTS FOR BURNS SURGERY

Thank you for your letter dated 20 August 2013, addressing the issues raised by the Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has formally **approved** the above mentioned study.

Approval is granted for one year till the 30 August 2014.

Please submit a progress form, using the standardised Annual Report Form, if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

Please add the HREC contact details (Prof M Blockman 0214066492/0214066338) to the I/C document.

Please note that the on-going ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

sAriefdien

Appendix 7

Author guidelines for the South African Journal of Anaesthesia and Analgesia

Author Guidelines

How to submit your paper online:

1. Registered authors must login to submit a paper
   - REGISTER HERE if you do not have a username and password
   - LOGIN HERE if you have already registered with SAJAA
2. Select Author
3. Click on CLICK HERE TO FOLLOW THE FIVE STEPS TO SUBMIT YOUR MANUSCRIPT
4. Follow the five steps to submit your paper
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Review policy and timelines

1. Immediate notification if submitted successfully
2. Notification within 3 weeks if not accepted for further review
3. Notification within 3 months if accepted for publication, if revisions are required or if rejected by both reviewers.
4. Publication within 6 months after submission.

Aims, scope and review policy

The *African Journal pf Primary Health Care and Family Medicine* aims to publish original research and review articles of relevance and interest to the in primary health care practitioners, family medicine specialists and academics from both the developing and developed worlds, public sector and private practice. Papers are peer reviewed to ensure that the contents are understandable, valid, important, interesting and enjoyed. All manuscripts must be submitted online. All articles in PHCFM will be peer reviewed.

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The author guideline is available in HTML format for convenience, as it contains large information. If you experience any difficulties please do not hesitate to contact us. For a video tutorial showing you how to submit your manuscript click here.

The following contributions are accepted (word counts exclude abstracts, tables and references):

* Original research (3500 and 5000 words)

* Scientific Letters(1000 words]

* Review Articles (4000 words]

* Correspondence (500 words]

* Book reviews [500 and 1000 words]

* Case studies [500 and 1000 words]

* Conference reports, proceedings and abstracts [1000 words]

* Educational material [3500 words]

Please see the journal's section policies [section policies]() for further details.

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Title page: All articles must have a title page with the following information and in this particular order: title of the article; surname, initials, qualifications and affiliation of each author; the name, postal address, e-mail address and telephonic contact details of the corresponding author; at least 5 keywords.

Abstract: All original and review articles should include an abstract of around 250 words. The structured abstract for an Original Research article should consist of five paragraphs labelled Setting, Objective, Methods, Results and Conclusion. Abstracts for other types of articles need not follow the structured abstract format.

Structure of article: Original research articles should be organised according to the following sections: Introduction, Method, Results, Discussion and References.

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Acknowledgements: In a separate section, acknowledge any financial support received. This section may also be used to acknowledge substantial contributions to the research or preparation of the manuscript made by persons other than the authors.

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The style for references should follow the format set forth in the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" prepared by the International Committee of Medical Journal Editors.

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Tables: Tables should be self-explanatory, clearly organised and supplemental to the text of the manuscript. Each table should include a clear descriptive title on top and numbered in Arabic numerals (1, 2, etc) in order of its appearance as called out in text. Tables must be inserted in the correct position in the text, or uploaded separately as supplementary files. Authors should place explanatory matter in footnotes, not in the heading. Explain all nonstandard abbreviations in table footnotes. For footnotes use the following symbols, in sequence: *,†,‡,§,‖,,**,††,‡‡.

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